

PATENT COOPERATION TREATY

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Assistant Commissioner for Patents
 United States Patent and Trademark
 Office
 Box PCT
 Washington, D.C. 20231
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in its capacity as elected Office

Date of mailing (day/month/year) 18 May 2000 (18.05.00)	
International application No. PCT/SE99/01652	Applicant's or agent's file reference 98003 UTAP
International filing date (day/month/year) 22 September 1999 (22.09.99)	Priority date (day/month/year) 28 September 1998 (28.09.98)
Applicant SANDSTRÖM, Roger	

1. The designated Office is hereby notified of its election made:



in the demand filed with the International Preliminary Examining Authority on:

18 April 2000 (18.04.00)



in a notice effecting later election filed with the International Bureau on:

2. The election ☒ was

was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

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Facsimile No.: (41-22) 740.14.35

Authorized officer

Nestor Santesso

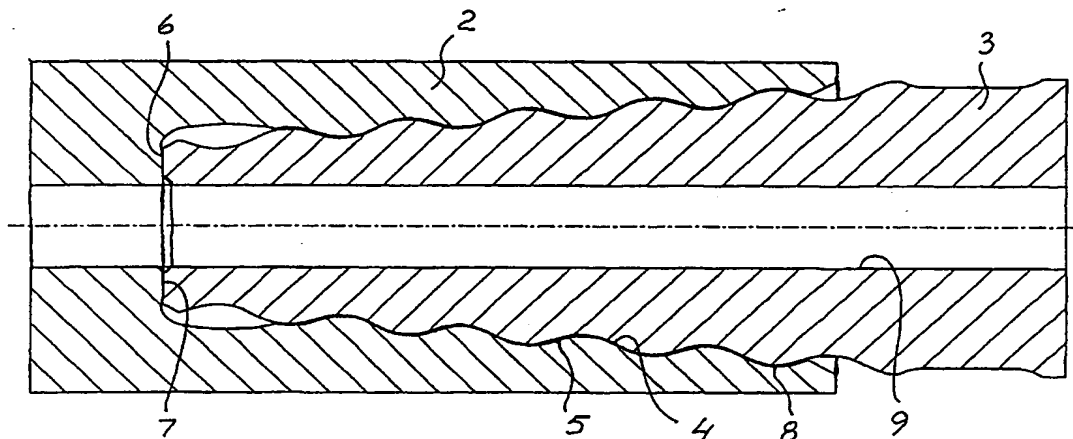
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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁷ : E21B 17/042	A1	(11) International Publication Number: WO 00/19056 (43) International Publication Date: 6 April 2000 (06.04.00)
(21) International Application Number: PCT/SE99/01652 (22) International Filing Date: 22 September 1999 (22.09.99) (30) Priority Data: 9803267-5 28 September 1998 (28.09.98) SE (71) Applicant (for all designated States except US): UNIROC AB [SE/SE]; P.O. Box 521, S-737 25 Fagersta (SE). (72) Inventor; and (75) Inventor/Applicant (for US only): SANDSTRÖM, Roger [SE/SE]; Ekallén 4, S-737 40 Fagersta (SE). (74) Agent: GRUNDFELT, Gunnar; Atlas Copco Rock Drills AB, Patents, S-701 91 Örebro (SE).		(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG). Published <i>With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>

(54) Title: THREAD COUPLING FOR A DRILL STRING FOR PERCUSSIVE ROCK DRILLING



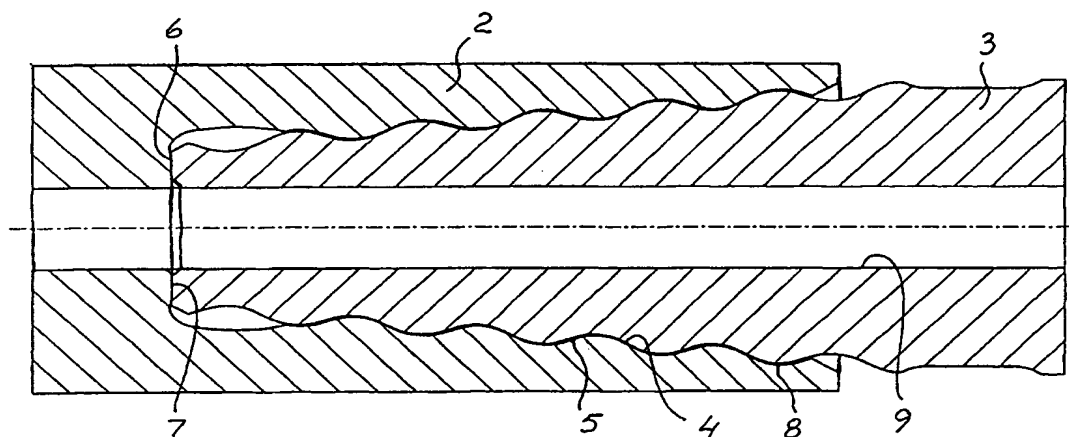
(57) Abstract

Thread coupling for a drill string for percussive drilling. The thread coupling is provided with a male thread (5) and a female thread (4) cooperating therewith. The male thread is arranged on a first drill string element (3) provided with a first impact surface (6). The female thread is arranged on a second drill string element (2) which is provided with a second impact surface (7). The threads are conical. Furthermore the crests (8) of the male thread (5) have a radius of curvature which is more than 30 % of the pitch of the thread.

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Thread coupling for a drill string for percussive drilling. The thread coupling is provided with a male thread (5) and a female thread (4) cooperating therewith. The male thread is arranged on a first drill string element (3) provided with a first impact surface (6). The female thread is arranged on a second drill string element (2) which is provided with a second impact surface (7). The threads are conical. Furthermore the crests (8) of the male thread (5) have a radius of curvature which is more than 30 % of the pitch of the thread.

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Thread coupling for a drill string for percussive rock drilling

The present invention relates to a thread coupling for a drill string for percussive rock drilling.

In previously known thread couplings for percussive rock drilling one sometimes obtains breakage of the drill rod adjacent to the drill bit and on the skirt of the drill bit adjacent to the inner end of the thread of the drill bit. These breakages occur in particular when the collaring conditions are bad. The cause of these breakages is that the drill rod adjacent to its end surface in contact with a bottom impact surface on the drill bit is prestressed by the deformations occurring at the shock wave passage through the thread coupling in combination with the applied torque. A corresponding prestressing is obtained in the skirt of the drill bit.

The present invention, which is defined in the subsequent claim, aims at achieving a thread coupling which avoids these breakages through forming the thread coupling such that the material thickness becomes optimal at those parts on drill rod and drill bit which are most sensitive to breakage. This is achieved by means of a combination of conical threads and a well rounded crest of the threads. It has turned out to be advantageous to have a radius of curvature at the crest of the thread on the male thread which is at least 30% of the pitch of the thread. The conical thread form means that the prestressing of the thread is moved away from the contact surface between the end surface of the drill rod and the bottom impact surface. This effect is achieved because the pitch angle of the thread is larger at smaller thread diameter than at larger thread diameter, constant pitch.

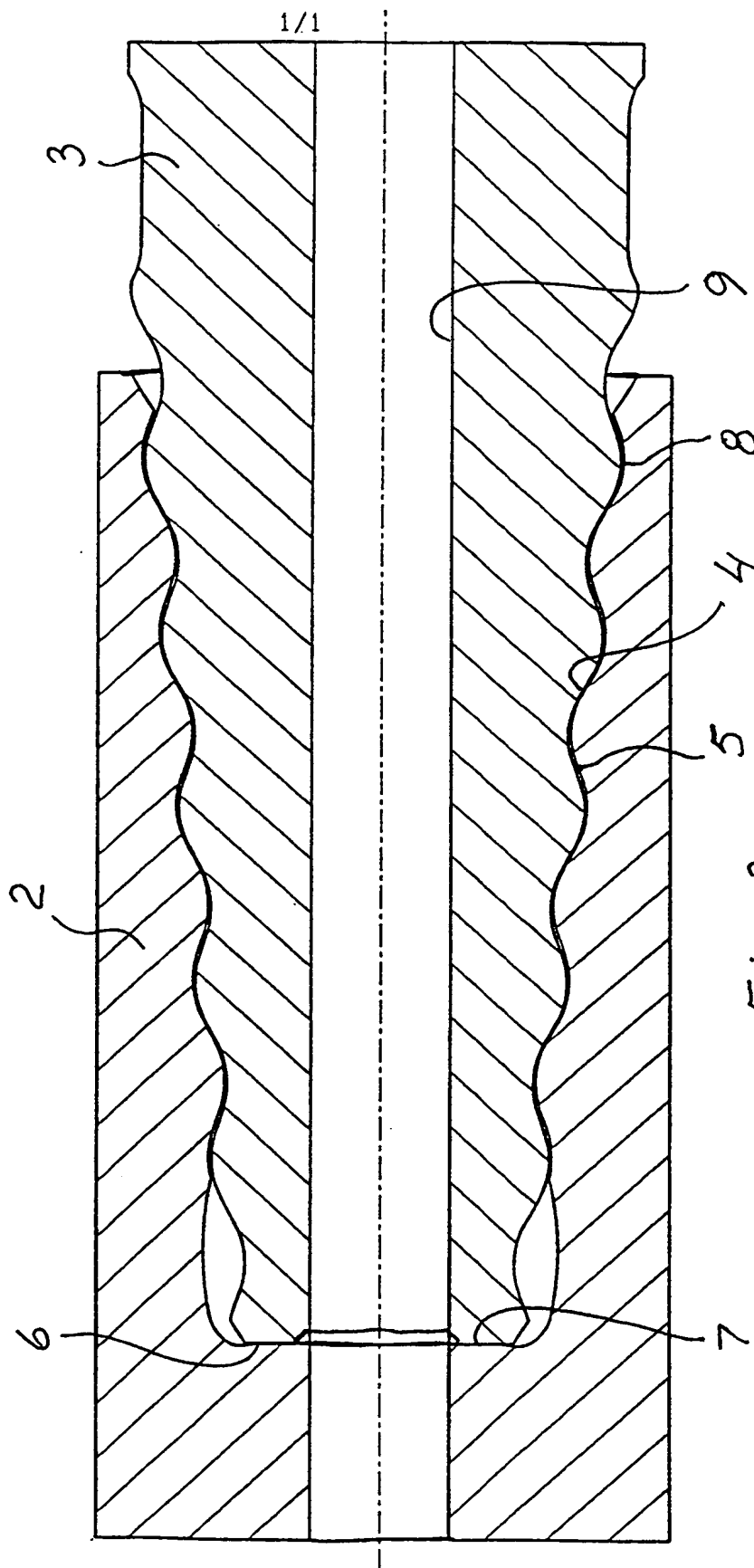
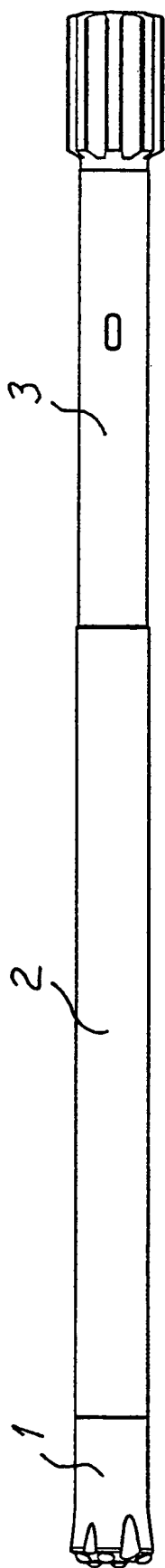
An embodiment of the invention is described below with reference to the accompanying drawing in which fig 1 shows a drill string with a thread coupling according to the invention. Fig 2 is a section through a thread coupling according to the invention.

The drill string shown in the drawing comprises a drill bit 1, a drill rod 2 and a shank adapter 3. Instead of a drill rod as shown one can have several. Drill bit, drill rod and shank adapter are drill string elements. The thread coupling shown in the drawing comprises a

male thread 5 arranged on a first drill string element 3 and a female thread 4 arranged on a second drill string element 2. The first drill string element 3 is provided with a first impact surface 6. The second drill string element 2 is provided with a second impact surface 7. In the shown example contact is obtained between the impact surfaces 6,7 at the bottom of the female thread. One can alternatively form the drill string element such that one obtains contact at the outer end of the female thread. In this case the drill string element with the male thread is provided with an impact surface at the end of the male thread which is farthest away from the end of the drill string element. The drill string elements are provided with a central flushing channel 9. The male thread 5 and the female thread 4 are conical with constant pitch. It has turned out to be advantageous to make the thread with a cone angle which is smaller than 20° . This means that the pitch angle of the threads increases when the diameter decreases. Through this the largest load on the threads is moved away from the area where known technique has had a tendency to give thread breakage. Since the crests 8 of the male threads 5 have been given a radius of curvature which is more than 30% of the pitch of the thread good transfer of shock wave energy is obtained without overloading of the thread coupling.

Claim:

1. Thread coupling for a drill string for percussive rock drilling comprising a male thread (5) and a female thread (4) cooperating therewith, said male thread being arranged on a first drill string element (3) and said female thread being arranged on a second drill string element (2), that said first drill string element (3) has a first impact surface (6) and that said second drill string element (2) has a second impact surface (7), said first and second impact surfaces being arranged to abut against each other, characterized in that said male thread (5) and said female thread (6) are conical and that the crests (8) of said male thread (5) have a radius of curvature which is larger than 30% of the pitch of the thread.



INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 99/01652

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: E21B 17/042

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: E21B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPODOC, WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 3933210 A (S.C. SKIDMORE), 20 January 1976 (20.01.76) --	1
A	SE 460550 B (SANDVIK AB), 23 October 1989 (23.10.89) --	1
A	NO 74549 C (AKTIEBOLAGET ATLAS DIESEL), 7 February 1949 (07.02.49) -- -----	1

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"I" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

27 January 2000

Date of mailing of the international search report

12 -02- 2000

Name and mailing address of the ISA/

Swedish Patent Office

Box 5055, S-102 42 STOCKHOLM

Facsimile No. +46 8 666 02 86

Authorized officer

Christer Bäcknert / MR

Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT
Information on patent family members

02/12/99

International application No.
PCT/SE 99/01652

Patent document cited in search report			Publication date	Patent family member(s)	Publication date
US	3933210	A	20/01/76	NONE	
SE	460550	B	23/10/89	AT 82615 T CA 1291880 A DE 3782688 A EP 0253789 A,B FI 86664 B,C FI 873102 A IE 60576 B JP 63067418 A SE 8603118 A US 4861209 A ZA 8704990 A	15/12/92 12/11/91 24/12/92 20/01/88 15/06/92 16/01/88 27/07/94 26/03/88 16/01/88 29/08/89 14/01/88
NO	74549	C	07/02/49	NONE	

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 98003 UTAP	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/SE99/01652	International filing date (day/month/year) 22.09.1999	Priority date (day/month/year) 28.09.1998
International Patent Classification (IPC) or national classification and IPC ₇ E21B 17/042		
Applicant Uniroc AB et al		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 3 sheets, including this cover sheet.

☐ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of _____ sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand 18.04.2000	Date of completion of this report 28.08.2000
Name and mailing address of the IPEA/SE Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Facsimile No. 08-667 72 88	Authorized officer Christer Bäcknert / MRO Telephone No. 08-782 25 00

Form PCT/IPEA/409 (cover sheet) (January 1994)

I. Basis of the report

1. This report has been drawn on the basis of *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.)*:

- ☒ the international application as originally filed.
- ☐ the description, pages _____, as originally filed,
pages _____, filed with the demand,
pages _____, filed with the letter of _____,
pages _____, filed with the letter of _____.
- ☐ the claims, Nos. _____, as originally filed,
Nos. _____, as amended under Article 19,
Nos. _____, filed with the demand,
Nos. _____, filed with the letter of _____,
Nos. _____, filed with the letter of _____.
- ☐ the drawings, sheets/fig _____, as originally filed,
sheets/fig _____, filed with the demand
sheets/fig _____, filed with the letter of _____,
sheets/fig _____, filed with the letter of _____.

2. The amendments have resulted in the cancellation of:

- ☐ the description, pages _____
- ☐ the claims, Nos. _____
- ☐ the drawings, sheets/fig _____

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the supplemental Box (Rule 70.2(c)).

4. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**1. Statement**

Novelty (N)	Claims	1	YES
	Claims		NO
Inventive step (IS)	Claims	1	YES
	Claims		NO
Industrial applicability (IA)	Claims	1	YES
	Claims		NO

2. Citations and explanations

The invention relates to a thread coupling for a percussive drilling string. It is intended to solve the problem of thread breakage on the drill rod adjacent the drill bit and on the skirt of the drill bit adjacent the inner end of the bit. The invention solves this problem by forming the thread coupling such that the material thickness becomes optimal at the parts of the coupling, which are most sensitive to breakage.

According to the claim, the thread coupling is formed with a conical male thread on a first drill string element provided with a first impact surface, and a conical female thread on a second drill string element provided with a second impact surface. Further, the crests of the male thread are formed with a radius of curvature that is more than 30 per cent of the pitch of the thread.

The cited documents disclose prior art thread couplings for percussive drilling. Thus, US 3933210 A shows a conical thread coupling, suitable for both rotational and percussive drilling. SE 460550 B shows a cylindrical thread joint for percussive drilling, wherein the radii of curvature of the threads are specified in order to prolong the service life of the joint.

However, the radii of curvature in the Swedish document are all smaller than the pitch of the thread and the threads in the American document could not be said to have a radius of curvature. Thus, the claimed invention is new and it is considered to be non-obvious to a person skilled in the art, in view of the disclosures of the cited documents. Further, it is considered to constitute a solution to the stated problem.

Consequently, the subject matter of the claim is considered to meet the criteria of novelty, inventive step and industrial applicability.

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Name and mailing address of the ISA/

Swedish Patent Office

Box 5055, S-102 42 STOCKHOLM

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Authorized officer

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INTERNATIONAL SEARCH REPORT
Information on patent family members

02/12/99

International application No.
PCT/SE 99/01652

Patent document cited in search report			Publication date	Patent family member(s)	Publication date
US	3933210	A	20/01/76	NONE	
SE	460550	B	23/10/89	AT 82615 T CA 1291880 A DE 3782688 A EP 0253789 A,B FI 86664 B,C FI 873102 A IE 60576 B JP 63067418 A SE 8603118 A US 4861209 A ZA 8704990 A	15/12/92 12/11/91 24/12/92 20/01/88 15/06/92 16/01/88 27/07/94 26/03/88 16/01/88 29/08/89 14/01/88
NO	74549	C	07/02/49	NONE	